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AN EPIDEMIOLOGICAL STUDY ON SPINAL INFECTION AND DERIVING A MANAGEMENT ALGORITHM

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ABSTRACT
Introduction: The infection in vertebral body, disc space and the intra and extra spinal structures is together called as Spinal infection. The treatment of such infection is multifaceted as it contains medical management alone or along with surgical intervention to drain infective pus or to debride the infected part and fuse the body. **Aims and objectives:** This study is planned in such a way to evaluate the presentation of spinal infection and also to derive a practical algorithm to be followed in spinal infections by applying the authors experience and also based on previous studies. **Methodology:** A total of 100 cases of Spinal infection who were treated in neurosurgery department of Kanyakumari medical college were studied prospectively from January 2015 to June 2018. **Conclusion:** A methodological assessment could lead to diagnostic effectiveness of spinal infection. Towards this, we present a management algorithm based on our study findings and previous literature.

KEYWORDS: Spinal infection, discitis, caries spine, surgical site infection.

INTRODUCTION
Spinal infection has a longer history with some descriptions dating from the Iron age.[1] But actual description of disease was made by Pott through tuberculosis infection in the spine, and a century later, Lanneloung, in France, reported for the first time the term pyogenic osteomyelitis of the spine.[2]

When intervertebral disc is affected by some sort of infection it is commonly described as discitis.[3] If it further invades the endplates or the vertebral body, the infection is labelled as vertebral osteomyelitis or spondylitis.[4] However, at the time of diagnosis in many cases, the infection has already compromised these two structures; therefore, both terms are frequently used while mentioning the infection i.e. Spondylodiscitis.

The signs and symptoms at clinical presentation are not too specific hence there will be a significant delay in establishing diagnosis and starting management. Some previous studies have revealed that a delay of 2–6 months between first symptoms and diagnosis[5,6] leads to bad prognostic outcome.

Through this study we like to propose an algorithm for diagnostic evaluation as well as current management options and their beneficial outcomes based on an extensive literature review followed by a study in hundred patients.

Epidemiology: Spinal infection will be presenting commonly with any of following types like, infection of Vertebral body termed as Vertebral osteomyelitis (or) Infection of body and disc together termed as spondylo-discitis (or) the epidural abscess either anterior (or) posterior. Spinal infection, accounts for 2–7% of all cases of musculoskeletal infections. Its incidence differs between 1:100,000 and 1:250,000 and its probable mortality rate ranges between 2-4%.[3,4] Numerous previous studies refer to a bimodal distribution with a peak below 20 years and between 50 and 70 years of age, representing in this group approximately 3–5% of all cases of osteomyelitis.[7] Further, a 2:1–5:1 male/female ratio has been reported from previous studies.[8] Known predisposing risk factors include previous spine surgery, a distant infectious focus, diabetes mellitus, advanced age, intravenous drug use, HIV infection, immunosuppression, oncologic history, renal failure, rheumatological diseases, and liver cirrhosis. In recent years, an increased incidence has been observed, due to a combined effect between an increase in susceptible populations (particularly history of previous spine surgery) and an improved accuracy in diagnosis.[9]

Spinal infection also sometimes occurs secondary to surgery-Surgical site infection occurs in 0.2 to 4% of operated individuals. This occurs commonly due to direct inoculation of organisms during Surgery. Whatever may be the mode and type of infection, spinal infection is certainly an unexplainably painful disease both for the patient and the surgeon who is treating.

Because the management protocol should be Evidence Based as well as experience based, it requires a lot of work ups and references to find out an appropriate line of management. This study involves extensive review of literature followed by evaluation among patients with the aim of formulating a protocol for treating the primary and secondary spinal infections.

Among the Spinal infections, Vertebral Osteomyelitis has an incidence of 2-4% of all osteomyelitis. It commonly occurs in immunocompromised patients. When there is involvement of more than one level of spine we should suspect tuberculous osteomyelitis. Vertebral OM commonly occurs in lumbar region followed by thoracic region.

Spinal Epidural Abscess occurs mainly due to bacteraemia, local extension of infection from skin like furuncles, following spinal procedures and in diseases like UTI, Endocarditis etc. It commonly occurs in thoracic region. About 82% of epidural abscess are located posterior to cord and rest 18% are located anterior to spinal cord.

Spondylodiscitis is infection of disc space with secondary involvement of cartileginous end plates and vertebral bodies. This may occur primarily in young patients who are immunocompromised or may present as secondary infection following spinal surgery. This spondylodiscitis commonly occurs in lumbar region.. Age wise it peaks at less than 20 years and above 50 years. The male: female ratio is 2:1 and the mortality ranges to 2 to 20%.

Post-operative spinal infection is also known as surgical site Infection (SSI) after spine surgery. The incidence is very low ie. 0.2 to 4% but the amount of physical and mental strain to the patient is exorbitant. This SSI can be classified into three types based on layer involved, Superficial SSI if infection is above facial layer, deep SSI if infection involves into muscles below fascia and organ SSI if infection is of deeper parts opened during surgery. Source of infection is 98% from airborne particle contamination in operation theatre, whereas 2% is from contamination from patient's skin.

Common symptoms seen were back pain, fever with or without chills, neurological deficits, and weight loss and muscle spasm.

Coming to investigations CRP, ESR, Total count are early indicators of infection and indices of control of infection. CRP is a specific marker, it will be elevated in more than 90% cases of spondylodiscitis and returns to normal rapidly on treatment. But ESR remains elevated in 50% of patients who show good recovery.

'X' rays and CT scans –show the extent of bony erosion, osteoporosis, angulations, deformities and instability. X - rays are useful to detect instability of the spine. CT shows early changes in endplates, bone necrosis and also useful in guided biopsy.

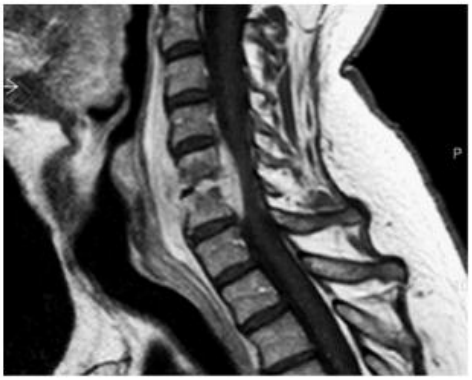
MRI – exhibits involvement of soft tissue and neural elements and presence of and multicentrical involvement of pus (or) granulation tissue. It has a High sensitivity of 96% and a Specificity of 94%. It is the Gold standard investigation in Spinal infection.

PET scan is useful in uncertain diagnosis as the degenerative spots and fractures will not demonstrate FDG uptake.

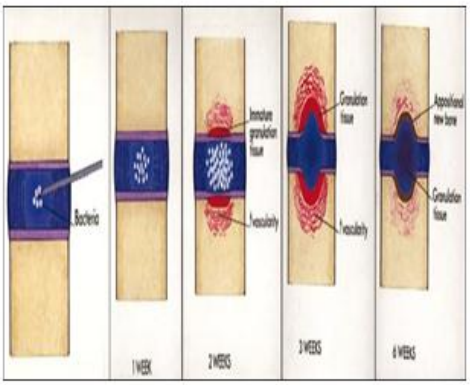
Other investigations like gram staining, AFB staining, blood culture, Culture of abscess drained, Histopathology of biopsy. Mantoux; PCR; Quantiferon TB Gold assay in case of TB spine may be required.

MRI – Spondylodiscitis.L2-3

CT –Shows Body erosion



MRI – Epidural abscess.C5-6



Stages of Discitis

In acute infections commonest organisms involved are Staph. Aureus followed by MRSA, Streptococci, E.Coli, Pseudomonas, Diplococci, Enterobacter. Whereas in chronic infection it can occur due to Tuberculosis, Brucellosis. Fungal infections like cryptococcosis, aspergillosis and parasitic infections like Echinococcus.

Management

Primary indications for surgery are for drainage of pus, Wound debridement, Source elimination, and relieving neural compression, obtaining samples for culture and sensitivity and HPE.

Medical Management includes 2 weeks of parenteral antibiotics like cefotaxime, Flucloxacillin, Ciprofloxacin followed by oral drugs with high bioavailablity like Linezolid or Clindamycin as recommended by Infections Disease Society of America (IDSA). Two weeks of appropriate parenteral antibiotics followed by 6 weeks of oral antibiotics is routinely followed. In case of Pott's spine WHO regime is intensive phase for 2 months with 4 drugs. Eg INH/RFM/SM/PZI followed by continuation phase for 4months with 2 drugs. Eg. INH/ RFM.

MATERIALS AND METHODOLOGY

A prospective and retrospective study was performed in all infectious spinal disease cases presenting from January 2015 to June 2018 at Kanyakumari medical college hospital in neurosurgery department. Cases fulfilling the following criteria were enrolled on the basis of clinical, radiological, laboratory, pathologic, and microbiological data.

Clinical symptoms suggestive of infectious spinal disease: fever or chill, axial pain, limb pain or numbness, neurologic deficit. Laboratory abnormalities as below white cell blood count (WCC) $>10000\times10^6$/L, erythrocyte sedimentation rate (ESR) >20 mm/h, C-reactive protein (CRP) >5 mg/dL. Radiologic abnormalities like spondylitis, discitis, epidural abscess, perispinal abscess and/or pyomyositis on magnetic resonance images (MRI). Pathologic findings like granuloma formation in case of tuberculous spondylitis. Microbiological results from blood cultures, percutaneous fine needle aspiration, percutaneous bone biopsy or open surgery.

The patients who refused any evaluation or treatment or the cases of superficial wound infection were excluded.

Patients without any positive results from the microbial studies were regarded as cases of pyogenic infection, if they showed characteristic radiologic findings consistent with spinal infection, clinical response to antimicrobial therapy, and their histology not showing granulomatous finding. Patient demographics, risk factors, clinical features and outcomes were assessed. Risk factors entailed the presence of diabetes, chronic renal failure and cirrhosis of liver, intake history of immunosuppressant, remote infection, and underlying malignancy.

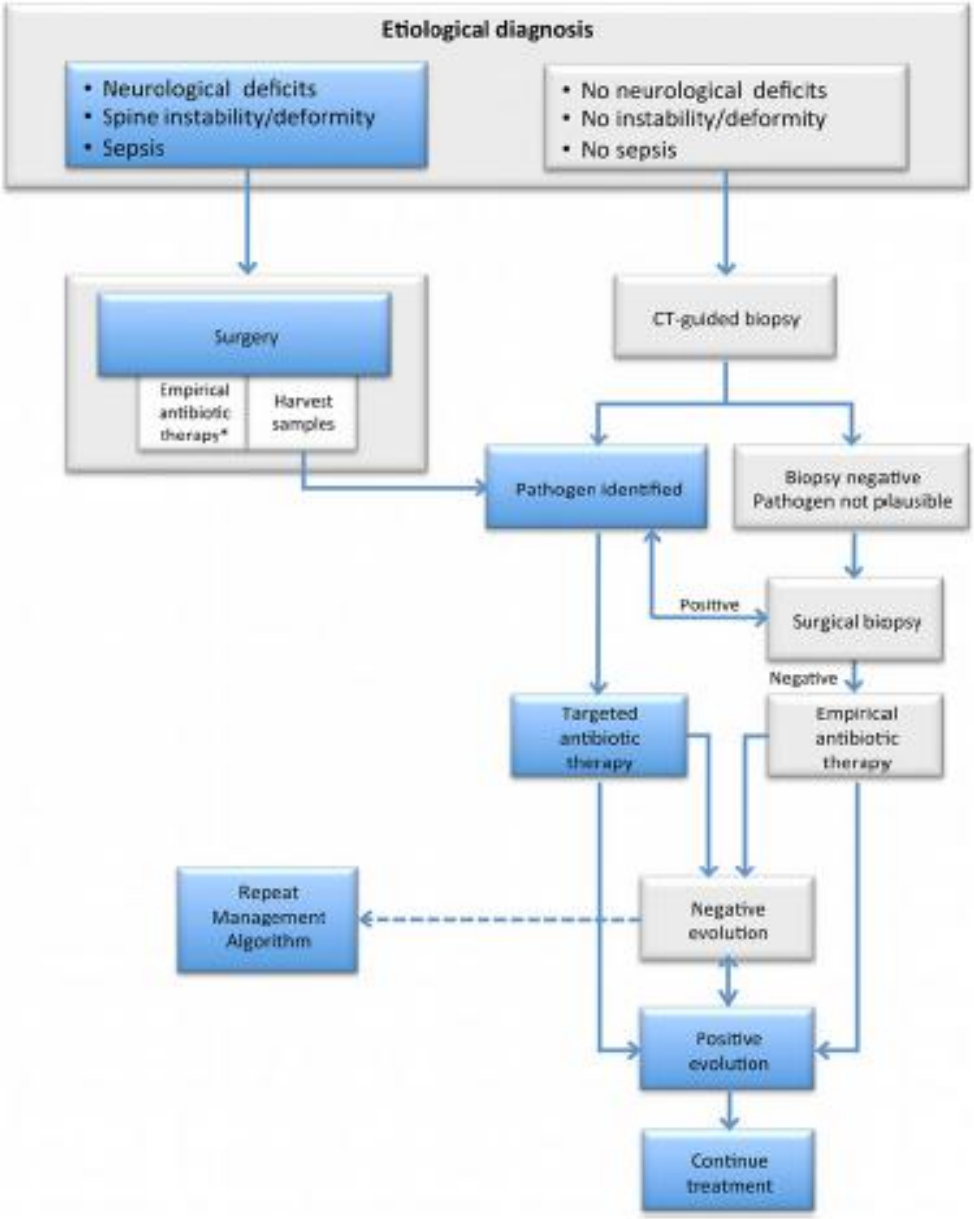
RESULTS

Hundred cases fulfilled the inclusion criteria and were reviewed. There were 65 males and 35 females. Among our study group most of the patients were above 45 age group. Disease wise spondylodiscitis was seen in 78 cases among which the aetiology was surgical site infection in 12 cases, pyogenic infection in 24 cases followed by TB spine in 42 cases. Epidural abscess was 10 cases among which abscess was present in cervical region in two cases and lumbar region in rest eight cases. Vertebral osteomyelitis were seen in 6 cases. The lumbosacral spine was the most frequently affected region with 72 patients had lumbar involvement generally.

Among the predisposing factors previous spinal surgery or procedure was the most commonly seen risk factor (N=21) among which the aetiology was surgical site infection in twelve cases in our study, followed by diabetes (N=15). Previous spinal surgeries or procedures include percutaneous procedures like spinal nerve block, discography and endoscopic discectomy, and open surgery such as discectomy, laminectomy and spinal arthrodesis.

Back or neck pain was by far the most common presenting symptom in our patients seen in 82% of patients. The number of patients with fever was 30. Neurologic deficits at presentation such as limb weakness, paralysis, or sensory loss were seen only in 12 patients.

MANAGEMENT ALGORITHM IN SPINAL INFECTION



DISCUSSION

Infectious spinal disease is not a common disease, but its occurrence seems to be on the rise. Even though there is advanced surgical techniques making operations shorter and its wound smaller and various newly developed antibiotics, the incidence of infectious spinal disease is getting higher as a result of larger proportion of the older patients with chronic debilitating disease[10] In India like other developing countries tuberculous disease is commonly seen. Lee et al.[11] reported 85% of primary spinal infection were tuberculous infection while another study[12] reported 71% of spondylitis were TB as cause. Another study done in 2001 by Park et al[13] reported that spondylitis patients who had been managed surgically were diagnosed as tuberculous spine infection. But of late there is decrease in incidence of tuberculous spinal infection due to vaccination of tuberculosis and anti-tuberculosis medication and the incidence of pyogenic infection seems to rise as results from increase of spinal procedures or surgeries and misuse of antibiotics.[14] In a recent study by Kim et al.[15] reported pyogenic spondylodiscitis (62.7%) as more frequent cause than tuberculous spondylodiscitis (37.3%). But in our study,

similar to previous studies tuberculous infection were common.

The known risk factors of the infectious spinal disease are diabetes, liver cirrhosis, underlying malignant disease, end stage renal disease, infection at remote site and any other immune compromised conditions.[16] In our study, 21% of all infectious patients have had spine surgery or invasive procedure which was proven as the most predisposing factor among which surgical site infection itself was seen in 12 cases. We cannot state that all these surgeries and procedures effected infection, and cannot conclude that previous spinal surgery or procedure become a definite risk factor, because this study was retrospective design and we could not exclude the patients whose infectious condition had been prior to their spinal surgery or procedures. The previous spinal surgery and procedure can cause spinal infection by direct inoculation of bacteria.

Infectious spinal disease may involve various skeletal structures such as vertebral body, intervertebral disc, epidural space and peri-spinal soft tissue. Among them, most common type of infection is spondylodiscitis. Generally, disc involvement of infection is occurred more frequently and earlier in pyogenic infection than in TB infections but in our study even TB infection were commonly seen.

The most important point for the treatment of spinal infection is the identification of etiologic microorganism. The procedures for this step include blood culture, percutaneous tissue biopsy and culture, and open biopsy and culture. When a spinal infection is suspicious, the blood culture is firstly performed, if neurologically stable, because it is the simplest. But it shows lower positive rates than any other procedures. When the result of blood culture is negative, the procedures for obtaining infected tissue should be considered before starting antibiotic treatment. The most common isolated etiologic microorganism causing infection in our study apart from Tuberculosis is *Staphylococcus aureus* followed by *E. coli*, like in most of previous studies.[17] Even among diabetics Staphylococcus was commonly seen.

CONCLUSION

Spinal infections remain a rare pathology, although an increased incidence has been reported due to increasingly more susceptible population and better diagnostic sharpness.

Due to the insidious onset, a high clinical suspicion remains the centrepiece of a quick diagnosis, which is essential to increase long-term outcomes and avoid everlasting neurologic deficits. Here microbiological and histological diagnosis plays main role towards the planning of specific therapeutic management. Therefore CT-guided or open biopsy should be considered a first line of investigation in suspected cases.

The treatment of spinal infections is mainly a nonsurgical treatment and comprises a specific antibiotic therapy accompanying with immobilization that decreases pain and helps averting segmental instability and deformity. Surgery is indicated for patients with neurological deficits or sepsis, spine instability and/or deformity, presence of epidural abscess, and in failure of conservative treatment. Once spinal infections disturb mainly the vertebral body and the intervertebral disc, surgical strategy should include appropriate anterior debridement of the infected tissues and reconstruction of the involved segments with bone construct, posterior decompression of neural elements, and instrumented stabilization can be supplementary or when posterior elements are involved.

By extensive review of literature the algorithm was obtained which is more practical, useful, unbiased, patient friendly and systematic. This Algorithm explains what has to be done in early stages of infection, late stages of infection, in case of presence of intra spinal and para spinal abscess and in the presence of deformity or instability.

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